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Science
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BULLETIN

OF THE SOCIETY OF ARTS



JANUARY, 1910

Professor Thomas A. Jaggar, Jr., in charge of the Department of Geology at the Institute of Technology, on "Japanese Volcanoes," Huntington Hall, Wednesday evening, January 12th, at 8 o'clock. Dr. Jaggar spent part of the spring of 1909 in Japan investigating the work of the government earthquake experts, and visiting several active volcanoes. Among these last was a remarkable mountain named Tarumai, in Yezo, the northern island of Japan, which had broken out into violent eruption just before Dr. Jaggar's arrival. He was able to visit the crater of this cone in the midst of its period of activity, and brought back remarkable photographs of a wonderful lava dome which rose in the midst of the crater.

Professor Charles R. Cross, in charge of the Department of Physics at the Institute of Technology, on "The Experimental Evidence for Modern Views as to the Nature of Electricity," in the Physical Lecture Room, No. 22 Walker Building, corner of Boylston and Clarendon Streets, Wednesday evening, January 26th, at 8 o'clock. Professor Cross will endeavor to explain in a general and non-technical manner the character of the evidence on which are based beliefs now held as to the nature of electricity. The lecture will be fully illustrated by experiments showing the principal phenomena of the electrical discharge in vacuo and of radio activity.

These lectures, which form part of the educational work of the Institute of Technology, are free. Persons interested in the aims of the Society are invited to join it.

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THE SOCIETY OF ARTS OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

The Society of Arts was established as a department of the Institute by President Rogers in 1861.

It is especially devoted to the general dissemination of scientific knowledge and it aims to awaken and maintain an interest in the recent advances and practical applications of the sciences.

Any person interested in the aims of the Society is eligible to membership.

The annual dues are \$3.

EXECUTIVE COMMITTEE

RICHARD C. MACLAURIN, President of the Institute.

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I. W. LITCHFIELD, Secretary, Massachusetts Institute of Technology, Boston

THE WONDERFUL VOLCANOES OF JAPAN

Those who were fortunate enough to hear Dr. Jaggar's lecture before the Society last year on the Messina earthquake will be much interested in the announcement that he is to address the next meeting of the Society of Arts on a subject which he has given particular study—"Japanese Volcanoes." Dr. Jaggar spent the spring and early summer in Hawaii and Japan, making special investigations in both localities and also examining the methods and instruments used by the Japanese in the systematic study of earthquakes. Dr. Jaggar was able to secure some beautiful pictures of these volcanoes, which he will show.

MODERN CONCEPTIONS OF ELECTRICITY

The lecture by Professor Cross on December 26th will give an opportunity to our non-professional members, who are not in intimate relations with the recent development of the theory of electricity, to get a good idea of the evidence on which are based our present beliefs as to its nature. Professor Cross is a teacher of rare skill and clarity, and this lecture will clear up the hazy notions that some of his hearers may have upon the subject.

The experiments will be very beautiful ones, and will include electrical discharges in vacuo and the principal phenomena connected with radio activity. The lecture will be held in the physics lecture room, No. 22 Walker Building, as it will be much more convenient to make the experiments there.

NEW MEMBERS OF THE SOCIETY OF ARTS

At the meeting of the Society, held Monday, December 6th, the following applicants for membership were presented and elected:—

GARDINER E. THORP, 49 Federal Street, Boston, Mass.
I. M. LEARNED, 674½ Tremont Street, Boston, Mass.
ROBERT A. BOIT, 40 Kilby Street, Boston, Mass.
THOMAS M. COOK, 187 Congress Street, Boston, Mass.
A. V. PHILLIPS, 89 State Street, Boston, Mass.
JOHN TAYLOR ARMS, JR., 3 Spruce Street, Boston, Mass.
H. C. GALLAGHER, 45 Broad Street, Boston, Mass.
EDWARD P. ROBINSON, 80 Border Street, East Boston, Mass.
WILLIAM H. HILL, 50 Congress Street, Boston, Mass.
L. L. COLE, 32 Franklin Street, Boston, Mass.
HERBERT G. PRATT, 88 Broad Street, Boston, Mass.
CHARLES K. FOX, Haverhill, Mass.
J. E. ALDEN, 547 Centre Street, Newton, Mass.
ISAAC SPRAGUE, 178 Devonshire Street, Boston, Mass.
FRED W. LOVELL, 69 Mt. Vernon Street, North Cambridge, Mass.
GUY C. EMERSON, 4 Brewer Street, Jamaica Plain, Mass.

At the meeting of the Society, held Thursday, December 16th, the following applicants for membership were presented and elected:—

ANTHONY MUSOLINO, Wilmington, Mass.
JOHN L. BARRY, 179 South Street, Boston, Mass.
H. CARLOS WILSON, Lewis Wharf, Boston, Mass.
JOHN D. WALKER, 70 State Street, Boston, Mass.
N. L. AMSTER, 82 Devonshire Street, Boston, Mass.
CHESTER P. DODGE, Beverly, Mass.
THEODORE N. VAIL, 125 Milk Street, Boston, Mass.

THE SANITARY DISPOSAL OF CITY WASTES

On December the sixth, Professor William T. Sedgwick, at the head of the department of biology of the Massachusetts Institute of Technology, delivered an address on "The Sanitary Disposal of City Wastes."

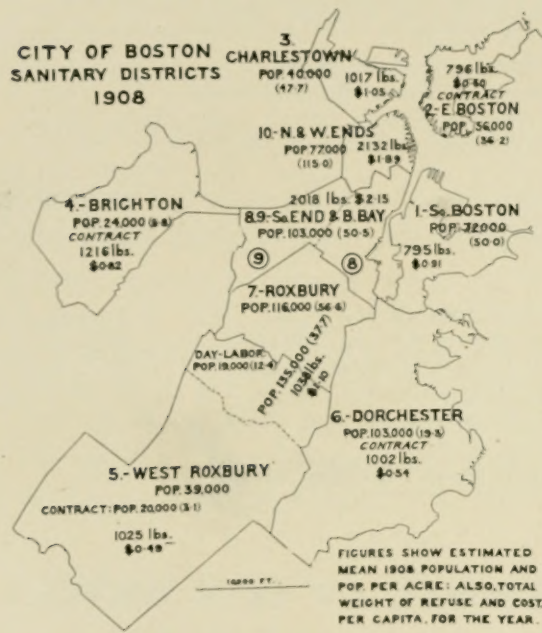
Professor Sedgwick said in part:

Whether we do or do not adopt the point of view of Herbert Spencer in his "Social Organism," there is no doubt that the analogy which has often been drawn between a living organism and a modern city is as useful as it is striking. Like the living organism the city has a various intake consisting in the case of the city in air, water, fuel, foodstuffs, immigrants, and raw and manufactured articles of various sorts. And on the other side it has an output of exhausted or worn-out materials, such

as steam, smoke, gases, sewage, ashes, garbage, rubbish, dirt, tin cans, empty bottles, scrap iron, mattresses, dead bodies and many other things.

But, while the public feels much interest in the intake, and is more or less solicitous as to the sources of the air supply, meat supply, water supply, milk supply, fuel supply, and particularly over the intake of manufactured articles from foreign countries, it feels but little interest in its wastes, which are generally not welcomed but thrust aside or got rid of as quickly and as cheaply as possible. This from the sanitary point of view is unfortunate, though it is perhaps not to be wondered at, for the

preparation of a meal is generally more interesting than the clearing away and washing up of the dishes, house building than house clearing, the loaded cartridge than the spent bullet. The reason underlying this difference in the public regard, lies in the fact that in the intake we have the promise and the potency of life, in the output the impotence and the poverty of exhaustion, the evidences of decay and death.



(Fig. 1)

Sanitary districts, City of Boston, 1908, with data concerning population, total weight of refuse, cost of collection *per capita*, etc.

The principal waste of a modern city consists of bad air, that is to say, air which has had more or less of its oxygen taken out by the fire or furnace through which it has passed and by the lungs of the people, and to which have been added the gases of combustion, the soot, the smells, and the smoke of a modern city. If Lord Kelvin ever said, as he is reported to have done, that we are in more danger of exhausting our oxygen supply than our coal supply, his statement is open to serious question, for unlike our coal supply our oxygen supply is constantly replenished through the agency of green plants, which in the

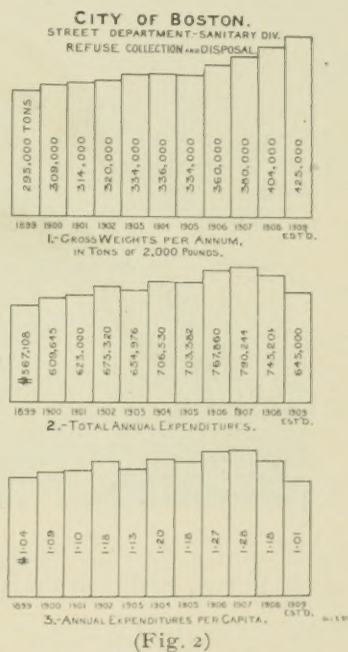
preparation of a meal is generally more interesting than the clearing away and washing up of the dishes, house building than house clearing, the loaded cartridge than the spent bullet. The reason underlying this difference in the public regard, lies in the fact that in the intake we have the promise and the potency of life, in the output the impotence and the poverty of exhaustion, the evidences of decay and death.

daytime, especially in summer, are pouring into the atmosphere vast quantities of oxygen and removing from it corresponding quantities of carbonic acid.

The multiplication of chimneys and the increasing use of soft coal are making it desirable that more attention than has yet been shown be given to the question of the disposal of these wastes. The problem is a difficult one, but appears to have been solved with much success in New York City by a strict enforcement of laws forbidding smoke production. Conditions in Boston, although greatly improved since the enforcement of similar laws was placed under the Board of Health, still leave much to be desired.

Next in importance to the output of bad air is the output of dirty water or sewage which if not purified is liable to produce serious nuisances of one sort or another. Boston is fortunate in being provided with excellent sewerage systems, although the present method of disposal of the sewage in the harbor is objectionable for the reason that the harbor ought to be regarded as one of the most precious possessions of the greater Boston, not only for its commerce, but also as a summer playground for the millions of people who live upon its borders or from the interior are turning toward the coast for rest and refreshment in the summer time. Sooner or later the pouring of unpurified sewage into the harbor ought to cease, to the end that the harbor and its shores may remain what they are to-day, one of the most precious sanitary assets of the city, the state and the nation.

The disposal of ashes, garbage, paper and rubbish is at present in the United States in an unsatisfactory condition, and there is some reason to believe that the principle of separation of these wastes into three groups,—ashes, garbage and combustible wastes,—introduced largely under the influence of the late Colonel Waring, has not proved to be all that was hoped, and may even have been a mistake. It is true that some financial return can be got by



Comparative weights and costs of refuse collection and disposal for ten years in the City of Boston.

the "reduction," so-called, of garbage, because of the grease which is recovered in the process, while the papers, wooden boxes and the like, under the form of combustible refuse, may yield some return if properly dealt with. At the same time the separate disposal of ashes, garbage and paper has in practice led to objectionable sanitary conditions, for the reason that the separation system breaks down at the very start, namely, with the householder, who rarely "separates" these things in more than the roughest fashion. The garbage may, in the separation system, be kept fairly free from paper, rubbish and ashes, but the ashes

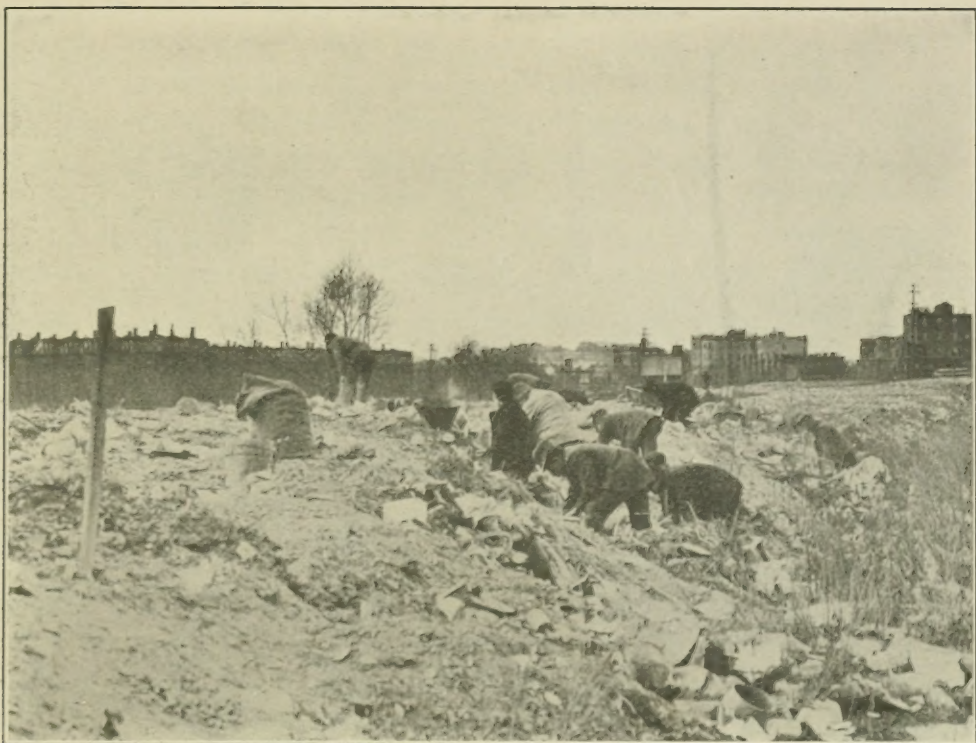


(Fig. 3)

Present method of dumping "ashes" at sea.

as a rule contain more or less garbage and paper, and the combustible wastes more or less ashes and garbage. If, as is the case in Boston, such "ashes" are emptied on inland dumps or into the sea, then the sanitary objection becomes serious, because in the former case the dumps are not only unsightly, but dusty or dirty, and readily become breeding places for

flies, while the papers mingled with the ashes are often set on fire, causing disagreeable odors, as well as fire dangers to the surrounding neighborhoods. Worst of all, rag pickers, coal gatherers, and others picking over the dumps, must of necessity come in contact with more or less infectious material, which they may take with them to their homes, forming there fresh foci of disease. The dumping of ashes at sea leads likewise to objectionable conditions on the beaches in the neighborhood, because "ashes," so-called, being in fact made up to some extent of papers, and sometimes of mattresses and the like, together with more or less garbage, contain floating materials, which readily create a nuisance.

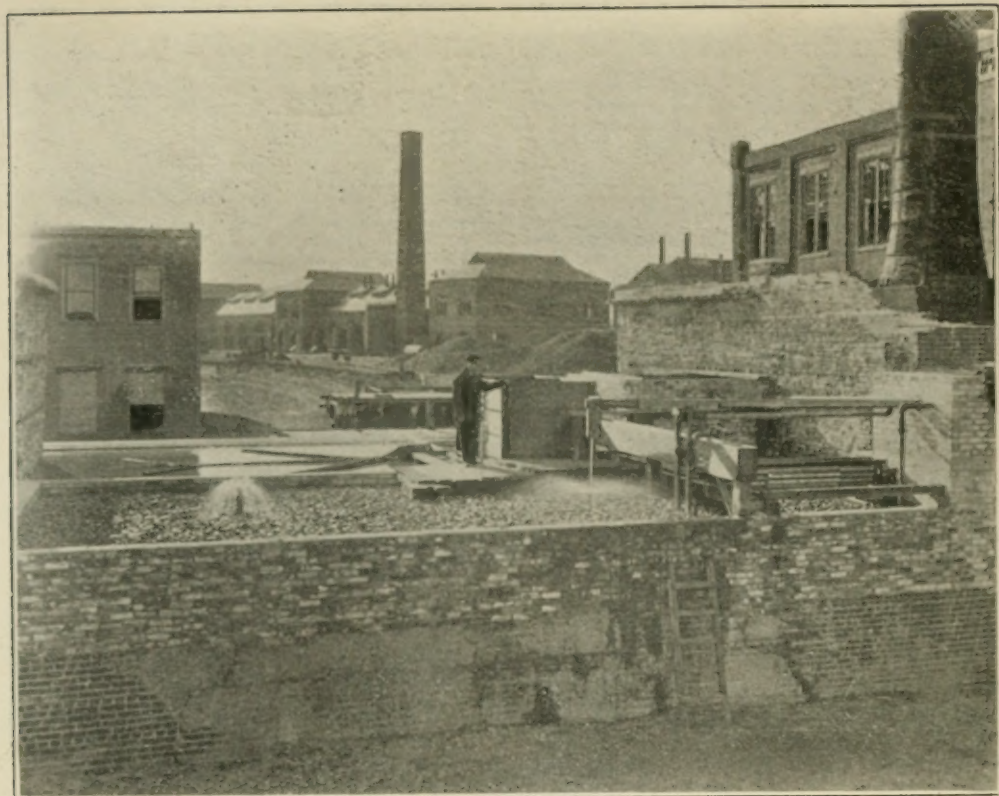


(Fig. 4)

A typical "Dump" in the Back Bay region. Theoretically only "ashes" are emptied here.

In view of these difficulties, some municipalities are turning toward incineration, which is a costly but, from the sanitary point of view, highly satisfactory process, in which separation is not aimed at, but everything,—ashes, garbage and combustible waste alike,—is put through a furnace and burned.

Fifty years ago, whenever a stranger visited an American city and was shown about, he was taken, not to parks, but to the cemeteries, for the reason that there were no parks, cemeteries serving in their stead. And if the present pre-emption of land for cemetery purposes continues and increases, this custom may come in again, because vast areas are now being given up in the vicinity of modern cities to earth-burial of the dead. Over against this plan stands that of cremation, which, from the sanitary point of view, is the only suitable method of disposal of the dead. Earth burial, although not necessarily dangerous to the living, is, to say the least, disagreeable to contemplate, while the speedy return of the body to the earth by fire—dust to dust and ashes to ashes—commends itself to every sanitarian.



(Fig. 5)

The new Sewage Experiment Station of the Massachusetts Institute of Technology at Old Harbor Point. Three experimental filters and two types of "Distributors" are seen in actual operation.

Much still remains to be done in the way of careful investigation and improved administration of methods of refuse disposal. It is, for example, not yet entirely clear whether, all things considered, the incineration of ashes, garbage and combustible wastes is the most desirable method in America, as it appears to be in England and in some other places. It may even turn out that clean ashes may well be disposed of at sea after thorough screening to remove effectually intrusive materials which do not belong there, reserving incineration for the combustible wastes and garbage, or possibly for so much of the garbage as can readily be "separated." For the study of sewage disposal, experiment stations have been established in many places, after the excellent example of the State Board of Health of Massachusetts, which, over twenty years ago, was far-sighted enough to establish on the banks of the Merrimac River the now famous Lawrence Experiment Station. And if more scientific and technical schools should follow the example of the Massachusetts Institute of Technology,

which, after five years of fruitful experimentation at a special Laboratory and Sewage Station on Albany Street, has recently opened a new and improved plant at Old Harbor Point, in Dorchester, for studies and demonstrations of methods of sewage disposal, even more rapid progress might be made in the future. It is also highly desirable that our experiment stations be no longer limited to work upon sewage, but furnished with facilities for experimentation upon the sanitary and economic aspects of the disposal of ashes, garbage and combustible refuse, as well as upon the gaseous wastes of cities, such as smoke, soot, and the odor-bearing gases from rendering plants and the like.

For two valuable diagrams (Figs. 1 and 2), giving interesting data concerning methods, quantities and costs in certain aspects of the refuse disposal problem in Boston, the writer is indebted to Guy C. Emerson, Esq., C. E. (M. I. T., 1889), Superintendent of Streets, City of Boston.

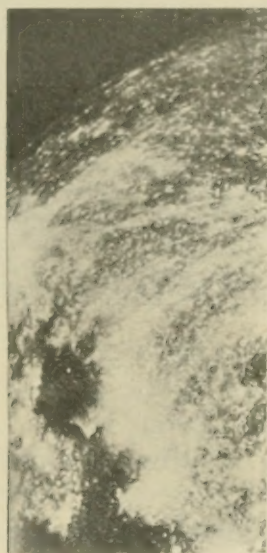
THE MOON AS A LIVING PLANET

On Wednesday, December 16th, Professor William H. Pickering, of Harvard College Observatory, addressed the Society on "The Moon as a Living Planet." He stated that the Moon had been called the satellite of the Earth, but more strictly speaking, it was its twin planet. Both the Earth and Moon really revolve about the Sun and mutually disturb one another's orbits. An observer on Venus, when it was between the Earth and the Sun, would see the Earth about two or three times as bright as Venus appears to us. The Moon would be as bright as Jupiter, and the two bodies would never be farther apart than the horns of the Moon as seen from our Earth. The Moon has sometimes been described as a place where nothing ever happens, but the lecturer was inclined to think that if the person responsible for this statement should be on the Moon for awhile, he would find that a great deal does happen there.



(Fig. 1)
The Full Moon.

Our satellite is about one quarter of a million miles from the Earth, and two thousand miles in diameter. The lunar day is fifteen terrestrial days long, and the lunar night the same length. The lunar day is its summer and the night is its winter. Students have varied in their conclusions as to the temperature of the Moon, some believing that it was hotter than boiling water and some that it is colder than freezing mercury. The best results have been obtained by Professor Langley, and later by Professor Very, who has stated that at midday on the Moon the temperature cannot fall very far below the boiling point of water, and at midnight it must be very near to the absolute



(Fig. 2)

Same region under low and high Sun, showing bright streaks in second view.

zero. It is probable that the temperature in the middle of the day is in the vicinity of 150 or 160 degrees. Nevertheless that fact would not prevent the existence of life on the surface of the Moon. In the hot geysers of the Yellowstone Park we find a form of vegetation called *algæ*, which can exist in a temperature of nearly 200 degrees.

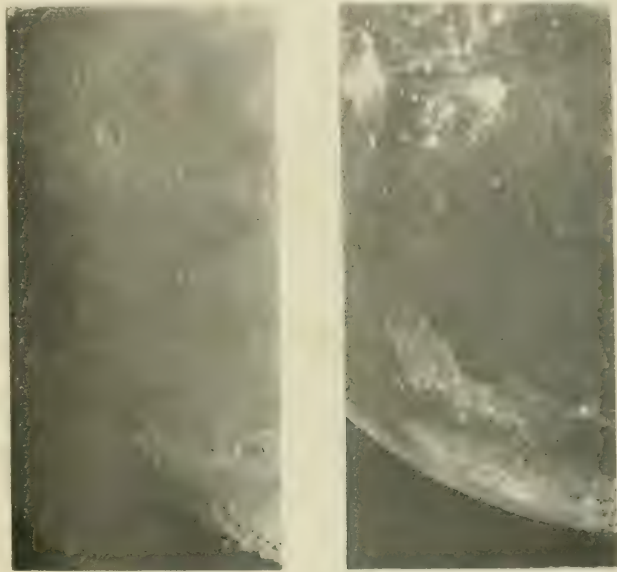
If that form of vegetable life can exist under such conditions, it seems probable that other forms of life can exist in as high a degree of temperature, as is found on the Moon. As far as extreme cold is concerned it has been found that after perfectly dry grain has been exposed to the temperature of liquid air the germinating quality is not impaired.

An erroneous belief generally exists of the power of large telescopes. The most important thing is to have a suitable climate, and in such a climate the most powerful telescopes might bring the Moon up so that we could see it as clearly as with the naked eye at a distance of 500 miles. It is doubtful, however, if anyone has ever seen

the Moon under such favorable conditions. He stated that a white object five or six hundred feet in diameter on a black ground would just be visible on the face of the Moon. No moving object has ever been seen there.

The surface gravity of the Moon is one sixth that of the earth; that is to say, a man weighing 180 pounds here would weigh 30 pounds there. One would have little difficulty in jumping over a small house. The main importance of this ratio, however, is that on the surface gravity depends the amount of atmosphere. The atmosphere of the Moon probably does not exceed in density one ten-thousandth that of the earth, although we cannot be certain that it is so small.

There is one reason for believing that the Moon may have a widely distributed atmosphere. When Jupiter is being occulted by the Moon, we find a black band crossing the surface of the planet, tangent to the sides of the Moon, and



(Fig. 3)

Same region under low and high Sun, showing changes in certain craters and none in others.

that black band seems to be due to the absorption of the light of the planet. It seems as though this absorption was due to the atmosphere of the Moon. Now any atmosphere belonging to the Moon must be made up of gases, which are being constantly given out by its volcanoes. In the case of the earth the two most prominent gases, which escape from volcanoes, are water vapor and carbonic acid. The amount of carbonic acid in a cubic foot of the Moon's atmosphere may be nearly as great as in that of the Earth. This is the most important gas for vegetation, so it is possible that the Moon's atmosphere may not be much inferior to the Earth's as a supporter of vegetable life. The water vapor would be retained but a short

time on the surface of the Moon. This does not interfere with its retention in the liquid form beneath the surface by capillary attraction. It is rather noticeable that the white regions, which may be due to frost or ice, and also the dark spots of variable density, places due probably to vegetation, are always found closely surrounding volcanic craters.

Professor Pickering threw a number of pictures of the Moon on the screen to show its peculiar craters. He also showed pictures of terrestrial volcanoes in order to show the analogy between their forms and those on the Moon. Referring to the theory which has occasionally been advanced that these crater-like formations are caused by the impact of meteors of enormous size, the lecturer stated



(Fig. 4)

Theophilus, showing grand central peak.

that about fifty years ago, Proctor, and since him, Gilbert and others, have advanced this theory. Professor Pickering sent out to an enthusiastic experimenter a photograph of a portion of the Moon's surface, and asked that something similar be reproduced by impact, with the stipulation that the small craters be made to impinge on the large ones as they do on the Moon. Large balls of clay were thrown against a plastic clay surface, and a photograph of the resulting

formation was shown on the screen. This result produced an appearance similar to that which would occur were large meteors hurled at the Moon, but the fact that in only one or two instances do large craters impinge upon the smaller ones, in the case of the Moon, proves that the lunar craters were not formed in that way. They were formed by volcanic agencies like those of the earth.

The lecturer then showed formations produced in cooling slag, showing on a small scale how volcanoes were produced. In the next slide the crater Tycho was shown. The lecturer called attention to the fact that in the group

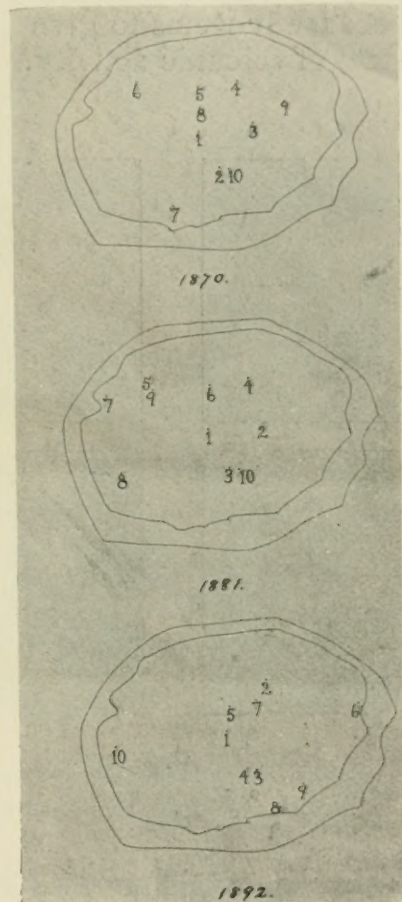
of craters Tycho was not as conspicuous as many of the others. In the next view, which showed several other craters, Tycho was very conspicuous, and white streaks were noticeable extending out from it in all directions for hundreds of miles. The interior of Tycho was shown to be very much whiter than the white streaks, and was surrounded by a dark ring which may be due to vegetation.

In a picture of Copernicus there were fainter streaks which were more curved.

Tycho's streaks were white, these were yellow. Professor Pickering stated that there were various explanations of the streaks but he was inclined to believe that the inner white areas were caused by snow, although the outer streaks could not be so explained. One explanation given for the streaks is that they may be due to pumice,—little balls of white material lying on a gray ground. As there is practically no atmosphere, the shadows would be absolutely black when the sun is low, the combined white and black giving a gray appearance. When the Sun rises there the shadows would disappear, and the area would, therefore, appear white. The best explanation, however, is that these streaks are due to vegetation. We have on the Earth a white lichen attached to our rocks, which is the first form of vegetable life that occurs in volcanic regions.

Photographs have been taken of the Moon, by Professor Wood, with the extreme ultra violet light, and he finds that there are certain small areas which are black in the violet light which come out white in ordinary light.

A view of Theophilus showed that the central peak

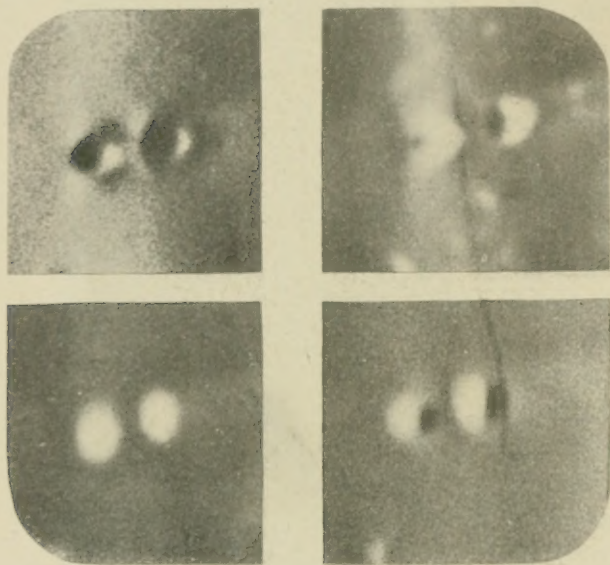


(Fig. 5)

Plato, showing changes in craterlets within its walls. The numerals indicate the relative brilliancy of the craterlets.

instead of being conical as in terrestrial craters, was deeply gullied (Fig. 4). In Copernicus this grooving was so deep that the central mountain is split up into three separate peaks. There are signs of rivers on the Moon but they differ from terrestrial rivers in that the apparent mouth is higher than the source. The water escapes in large quantities from the crater and as it crosses the surface of the moon gradually dries up and disappears. A picture of the crater Plato was shown, which was interesting because it seems to give good evidence that it is now in a state of volcanic activity. Different maps show something

like forty or fifty craterlets in Plato which are scattered all over its surface. The white regions were said to be variable, drifting about more or less. One view showed three drawings of Plato taken in 1870, 1881 and 1892. Each drawing showed the ten most conspicuous craterlets at these dates. In all cases it was seen that the central craterlet was the most conspicuous. Besides the central craterlet there were only



(Fig 6)

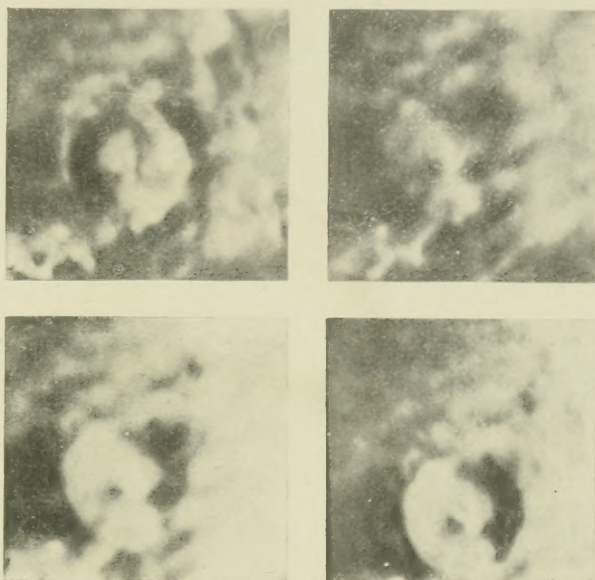
Messier and Messier A, showing changes in shape and relative size.

three others that showed in all three drawings. Professor Pickering stated that later drawings had been made but he had not yet had opportunity to work them up satisfactorily. These later drawings show great changes in appearance of this crater since the 1892 drawing was made (Fig. 5).

Another picture showed shadows stretching across the floor of the crater, the picture being drawn when the Sun was setting upon it. The striking feature of this picture was a large hill where thirty years ago nothing but a level plain was seen. It now looks like a bank of sand six or seven miles long and one and a half miles wide. It is

about a thousand feet high and was formed when a small nearby craterlet was opened. When we consider that this craterlet is over a mile in diameter we see that the volcanic action was very intense. The different pictures of the two craterlets, Messier and Messier A (Fig. 6) were taken at different times, and give wonderful emphasis to the changes that are continually taking place on the Moon. The walls do not change their forms but the white areas appear and disappear. The white portion is not snow but hoar frost.

Photographs of the full Moon show the white streaks going out from Copernicus, Tycho, etc. (Fig. 1). In 1840 Schmidt observed that the diameter of a crater called Linné was five miles, but in 1866 it had disappeared. There was nothing to be found at that time except a little hill. Later on a small crater appeared on the summit of the hill. This grew until it was a mile in diameter. It remained without change until 1892, when it was a mile and a half in diameter.



(Fig. 7)

Erastosthenes, showing variable spots due probably to vegetation.

Erastosthenes is one of the most interesting craters on the Moon on account of the variable dark spots which it contains. When these spots are best seen it is impossible for any shadows to exist since the Moon is full. The dark portions are, therefore, not due to shadows, and the only satisfactory explanation of them is that they are due to vegetation (Fig. 7).

NOTE.—Dr. Harvey W. Wiley, of Washington, D. C., will lecture before the Society on Wednesday evening, February 9th; subject, "The Exigencies of the Public Service."

